JUN 30

VOLUME IV NUMBER 2

AGRICULTURAL HISTORY

APRIL
1930

PUBLISHED QUARTERLY BY THE
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AGRICULTURAL HISTORY

VOLUME IV APRIL, 1930 NUMBER 2

CONTENTS

Page

ECONOMIC EFFICIENCY AND COMPETITIVE ADVANTAGES OF SLAVERY UNDER THE PLANTATION SYSTEM 31

L. C. GRAY

THE HISTORY OF AMERICAN WHEAT IMPROVEMENT 48

CARLETON R. BALL

NEWS NOTES AND COMMENTS 72

Published Quarterly by
The Agricultural History Society
At Mt. Royal and Guilford Avenues, Baltimore, Maryland.
Editorial Office, Room 301, 1358 B St., S.W., Washington, D. C.

Annual Membership, $3.00 Life Membership, $100.00

Entered as second class matter October 12, 1928, at the post office at Baltimore, Md., under the Act of March 3, 1879.

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AGRICULTURAL HISTORY

VOLUME IV APRIL, 1930 NUMBER 2

ECONOMIC EFFICIENCY AND COMPETITIVE ADVANTAGES OF SLAVERY UNDER THE PLANTATION SYSTEM

BY L. C. GRAY[1]

In the eighteenth century slavery displaced servitude as the principal labor basis of the plantation system in the South. During the post-Colonial period there was a continual process, which has been noted by several historians, and particularly by Professor U. B. Phillips, whereby slavery supplanted free white labor in areas well adapted to the commercial production of the Southern staples. The present paper is devoted to an interpretation of the competitive superiority which enabled slavery to displace other forms of labor.[1]

It will be unnecessary to devote much consideration to the displacement of indentured servitude. Servitude came into exist-

[1] Principal agricultural economist in charge, Division of Land Economics, Bureau of Agricultural Economics, U. S. Department of Agriculture. The address here printed was read at the joint meeting of the Agricultural History Society with the American Historical Association and other historical societies at Durham, N. C., on January 1, 1930.

The material included in this article is a product of research work carried on in a study of the history of Southern agriculture. This study was begun many years ago under the auspices of the Carnegie Institution, and was later financed by the Research Associates, Incorporated, of which organization Professor Henry W. Farnam is chairman. Portions of this article are excerpted verbatim from a manuscript on the general subject of Southern agriculture prior to 1860, which is approaching completion.

The conclusions here presented are based on a considerable mass of facts, mainly of a non-statistical character; and it is obviously impracticable in a brief paper to present supporting data. In fact, such conclusions can probably not be definitely proven, but must rest largely in the realm of hypotheses indicated by the known facts and relationships.

ence partly because of the slow development of the slave trade to the continental colonies and because colonial founders, not contemplating a slavery regime, adopted servitude as a convenient mode of colonization. It passed away as an important form of plantation labor partly because of certain general conditions not intrinsic in its competitive inferiority. Among these extrinsic conditions were the opposition of the English government to the trade, growing out of the changed attitude toward emigration of population from England. The trade in English servants was checked in part by acts of Parliament in the last years of the eighteenth century to prevent the transport to America of persons having manufacturing skill and by the prohibition of the transport of persons on English ships for the purpose of servitude for debt. The German tide of servants exhibited a preference for the middle colonies because of land engrossment in the South, the domination of social life by an aristocratic class, and the development of invidious distinctions against labor. Regulations to compel more humane methods decreased the profits of the servant trade, and profits were further reduced by the necessity of going farther into the interior to obtain redemptioners and by the opposition of German princes to the emigration of their subjects. After the Revolutionary War the domestic manufactures on plantations, which had furnished some demand for the labor of servants, were gradually supplanted by factory-made products or by the services of negroes who had acquired skill in handicrafts.

For purposes of field labor slavery involved also certain obvious advantages as compared with servitude. This superiority may be reviewed through the eyes of the colonial planter somewhat as follows: A servant for a 4-year term could be obtained, say, about the beginning of the eighteenth century for £10 to £15, while adult slaves could be had on the average for £18 to £20. The services of the slave were for life, as compared with 4 years for the servant, and the descendants of the slave would also belong to the planter. In spite of the cost of raising them, slave children were of some value at birth, in the continental colonies. The slave would be more difficult to train, but when broken in, was probably as efficient for field cultivation as the servant, and generally

more tractable. Women slaves could be employed as field hands, but women servants must find their place largely in domestic labor. The cost of maintaining a slave was somewhat less than for a servant, and there was no expense for freedom dues.

In view of the relative economic superiority of slave labor for field work and considering how much more rapidly the number of slaves multiplied in proportion to the number imported than was the case with servants, who were continually becoming freemen, it is not difficult to understand why slavery largely supplanted servitude in Southern agriculture.

The tendency for slave labor to displace free labor where conditions were favorable to producing and marketing the staples raises the question as to what economic characteristics gave slavery the advantage. Obviously this question involves neither the ethical aspects of slavery nor its social and economic advantages and disadvantages from the standpoint of national or sectional welfare. Unfortunately, however, the consideration of the economic aspects of slavery as a competitive institution have been largely mixed up with these broader considerations, resulting in a large amount of dogmatism and confusing seriously the nature of competition between the respective types of labor. The essential question is not whether the South would have been better off if its entire population had been made up of white laborers of west European origin working under the wages system; but whether the South could have employed the African negro, after he was brought to this country, in any more effective manner, and more than this, why the negro slave, in spite of the alleged inferiority of slavery as a method of stimulating exertion, was able to displace the economy of free white farmers.

There has been a tendency to confuse the industrial qualities peculiar to negro labor with the industrial incapacity attributable to the influence of slavery. This confusion has been largely the outgrowth of the arbitrary assumption that slave labor must be less economic because it is given grudgingly and half-heartedly. Turgot and Adam Smith promulgated this dogma, and it soon became a commonplace of economic generalization. Francis A. Walker gave the formula an eloquent presentation. The "whip",

he wrote, "only stimulates the flesh on which it is laid. It does not reach the parts of a man where lie the springs of action. No brutality of rule can evoke even the whole physical power of a human being."[2]

One essential fallacy of Smith and his followers was in assuming that if slave labor was less efficient in terms of physical performance than free labor, it must therefore be "dearer." The two things are not necessarily identical. Even though white labor be superior to negro slave labor in economic skill and adaptability, it is conceivable that the superior cheapness of the negro slave might result in enabling his master to outbid white labor in competition for land or to undersell it in disposal of products. As early as 1803 Jean Baptiste Say had pointed out that the owner of a slave was in a position to deprive him of all but subsistence, and this fact, he argued, explained the large profits of San Domingo planters.[3] Adam Smith himself had recognized the fact that the slave might be compelled to work for bare subsistence, but he swept it aside with the general argument that slave labor was dear because inefficient through lack of inducement.[4]

Say's significant point was not followed out in subsequent discussions of the competitive power of slavery, although occasionally admitted as a fact.[5] Generally the two points of view have been inextricably confused. Thus, Hodgson, who undertook to refute Say's point, argued that if slave labor were cheaper than free labor, it should hire for less, whereas he presented certain selected statistics to prove that the hire of slave labor was greater.[6]

[2] Francis Amasa Walker, *The Wages Question; A Treatise on Wages and the Wages Class* (New York, 1904), 73; E. R. A. Seligman, *Principles of Economics, With Special Reference to American Conditions* (New York and London, 1923), 158; Arthur Twining Hadley, *Economics; An Account of the Relations between Private Property and Public Welfare* (New York and London, 1899), 27–29.

[3] *A Treatise on Political Economy* (translated from the 4th ed. of the French by C. R. Prinsep, 2 v., Boston, 1821), 215–217.

[4] *Wealth of Nations*, bk. 1, ch. 8.

[5] Cf. Arthur Gibson, *Human Economics* (London and New York, 1909), 93; John Elliott Cairnes, *The Slave Power: Its Character, Career, and Probable Designs* (New York, 1862), 39.

[6] "A Letter to M. Jean-Baptiste Say, on the Comparative Expense of Free and Slave Labor," reprinted in *Remarks During a Journey Through North America in the Years 1819, 1820, 1821* (New York, 1823), 297–299.

It would appear rather strange, however, that the less productive and efficient labor would hire for more, and therefore Hodgson's argument proved too much. He and others discussed the relative cost of the two forms of labor and showed slave labor to be the more expensive by bringing up questions of interest and depreciation on capital value, which were included in costs through confusing phenomena growing out of the capitalization of a surplus over costs with the ultimate costs of utilizing labor.[7]

It is clear that three elements need to be kept carefully separated, first, the comparative efficiency of negro slave labor and free white labor; second, how much the efficiency of the former was affected by its employment through slavery rather than under a wage contract; and finally the comparative dearness or cheapness of the supply of the two forms of labor.

As to the relative efficiency of negro slave labor and free white labor employed for field operations in the production of Southern staples, the evidence is conflicting. There were a good many planters and employers who preferred negro slaves to white laborers. There were travelers who commented on the volume of work accomplished by negro slaves under the plantation system. On the other hand, there were observers who noted the carelessness and slipshod character of negro slave labor. A writer in the *American Farmer* declared, "There is perhaps not in Nature a more heedless, thoughtless human being than a Virginia field negro. With no care upon his mind, with warm clothing and plenty of food, under a good master, he is far the happier man of the two. His maxim is, 'Come day, go day, God send Sunday.' "[8] Frederick Law Olmsted was impressed with repeated instances of waste and carelessness, especially in regions where plantation organization was least well developed. He mentions, for instance,

"gates left open and bars left down, against standing orders; rails removed from fences by the negroes, as was conjectured, to kindle their fires with; mules lamed, and implements broken, by careless usage; a flat-boat, carelessly secured, going

[7] *Ibid.*, 291–299; Thomas Cooper, *Lectures on the Elements of Political Economy*, 107.

[8] *American Farmer*, XV, 139. Cf. also *Farmer and Planter* (Pendleton, S. C.), V, 230.

adrift on the river; men ordered to cart rails for a new fence, depositing them so that a double expense of labor would be required to lay them, more than would have been needed if they had been placed, as they might almost as easily have been, by a slight exercise of forethought; men ordered to fill up holes made by alligators or craw-fish in an important embankment, discovered to have merely patched over the outside, having taken pains only to make it appear that they had executed their task—not having been overlooked while doing it, by a driver; men, not having performed duties that were entrusted to them, making statements which their owner was obliged to receive as sufficient excuse, though, he told me, he felt assured they were false—all going to show habitual carelessness, indolence, and mere eye-service."[9]

Unquestionably Olmsted exaggerated the responsibility of slavery for these characteristics, which are frequently displayed by free negro laborers, even when working for themselves. It is further probable that a part of the carelessness and shiftlessness observed by Olmsted and others resulted from the lax supervision and easy-going spirit of interior regions where the economy was not predominantly commercial. Even Olmsted was impressed with the steadiness, strength, and effectiveness of negro labor under systematic direction in the capitalistic cotton plantations of the Southwest.[10] Specific contemporary estimates of accomplishment not infrequently indicate as large an average for slaves as for free laborers. Furthermore, statistics of wages paid for white labor compared with payments for slaves hired do not reflect an unquestionable tendency to evaluate one kind of labor higher than the other.

Sometimes the dogma was put forward that while negroes were an efficient type of labor for plantation use under the one crop system they were inferior in general farming. This conception was connected with the tendency to explain the unprofitableness of general farming in certain parts of the South by the assumption that for that type of farming slave labor was greatly inferior to free labor. Sometimes it was alleged that slave labor was less effective in general farming on account of the inability of negro

[9] *A Journey in the Seaboard Slave States, With Remarks on Their Economy* (New York, 1856), II, 114–116.

[10] Cf. *ibid.*, II, 114–115; *The Cotton Kingdom: A Traveller's Observations on Cotton and Slavery in the American Slave States* (New York, 1861), I, 13, 89, 118–136; *A Journey in the Back Country* (New York, 1860), 432.

slaves to employ machines intelligently. In most of the general farming areas of the South, however, but little farm machinery was employed, and what was used was scarcely more complex than was employed in producing the plantation staples. A larger amount of supervision per unit of labor was required than in less diversified forms of agriculture, but this was the case no matter what kind of labor was employed. The fact is, the unprofitableness of general farming, as explained later, rests on other grounds.

Much of the contemporary opinion concerning the intrinsic inefficiency of negro labor was due to attributing to slavery such characteristics of Southern agriculture as soil wastage, extensive methods of cultivation, and the one-crop system. In a paper read several years ago before this Association I endeavored to point out that soil wastage and extensive methods of cultivation were attributable mainly to the abundance of land in the South, rather than to slavery, and that slavery was compatible with intensive cultivation and conservative methods of utilizing soil, as illustrated by the rural economy of a number of the West India islands, the South Carolina-Georgia rice and sea island cotton region, and the Louisiana sugar region.

Considering the characteristic immediacy of the primitive negro, it is probable that the system of rewards and punishments of the plantation were more powerful stimuli toward industrial activity than the rewards of industry would have been for him under a system of free labor. By no means all slaves, however, were sullen, wretched, and driven cattle, working only under the lash.[11] On the smaller plantations, especially, they felt a vital interest in the affairs of the plantation, and their advice was not infrequently asked by the master. In many cases they took pride in the master's wealth and prosperity, tacitly accepting the position of inferiority and subordination—a position which probably caused them little sorrow.[12]

[11] The insensibility of many primitive races to the ignominy of slavery was pointed out with many illustrations by Wilhelm Roscher, in 1854. See his *Principles of Political Economy* (2 vols. Chicago, 1878) I, ch. IV, sec. 69.

[12] *Southern Agriculturist*, III, 601; *DeBow's Review*, XXV, 53; Sir Charles Lyell, *A Second Visit to the United States of North America* (New York, 1849), II, 78–82.

Slavery as an industrial system possessed certain positive advantages, even as compared with the system of wage labor. From the standpoint of the employer, slavery provided a stable labor supply. Barring ordinary accidents and sickness, the laborer's services were always available—an important advantage in large-scale farming.[13] There was possibly a certain degree of economic inelasticity in the supply of labor, particularly at harvest time, when there was little surplus labor except children;[14] and slave labor probably flowed less readily than free labor to the type of employment involving greatest economic opportunity,[15] due largely to lack of diversity in the negro's economic experience. It was found practicable to employ slave women in field labor, as well as men, while throughout America custom did not ordinarily sanction the employment of white women in the fields. Furthermore, it was practicable to use child labor from a comparatively early age in such activities as worming and suckering tobacco and picking cotton.[16] Slavery involved no problem of unemployment, and bred no lockouts, blacklists, or strikes.

INFLUENCE OF CAPITALIZATION ON COMPETITIVE STRENGTH OF SLAVE LABOR

The actual basis of the competitive power of negro slavery was greatly obscured by the phenomenon of capitalization, for the prospective series of annual incomes from the ownership of a slave were capitalized in a manner comparable to the capitalization of a terminable annuity or other terminable use-bearers. Thus, about the period of the Revolutionary War slaves were reported

[13] For presentation of this point of view see the *Southern Planter*, I, 138, 157; Edmund Ruffin, "Slavery and Free Labor Defined and Compared," in *Southern Planter*, XIX, 731–732; *DeBow's Review*, VIII, 71; *Hunt's Merchants' Magazine*, XXIX, 327.

[14] Richard Hildreth made much of this disadvantage; see his *Despotism in America: An Inquiry into the Nature, Results, and Legal Basis of the Slave-holding System in the United States* (Boston, 1854), 119.

[15] Cf. James Raymond, *Comparative Economy of Free and Slave Labor in Agriculture* (Frederick, 1827), 3–6.

[16] Cf. Robert Russell, *North America, Its Agriculture and Climate* (Edinburgh, 1857), 142.

to be capitalized at four to seven times the average annual hire.[17] In 1791 Thomas Jefferson estimated the ratio at five to one. Just before the Civil War, the rates of hire by the year in Missouri averaged 14 per cent of capital values in the case of male slaves and 16 per cent for females.[18]

In the case of the slave, the process of capitalization involved more obscurity than for bonds or other contractually pre-determined income, for it was necessary to estimate future earnings. As compared with land, the valuation of the slave involved uncertainties of loss by sudden death or incapacity for labor through disability. Although the actuarial risk presumably was discounted in the purchase price of slaves, the possibility of loss by death was a considerable element in the risks of the individual planter. The risk was greater for small than for large planters, and this fact, accentuated by the rising prices of slaves, appears to have been one of the reasons for the concentration of slave ownership which occurred just before the Civil War.[19] In the last two decades before the Civil War, however, insurance companies were beginning to insure the lives of slaves.[20]

The question of the relative competitive advantages of slave labor and of free labor was confused by the tendency to assume that the interest and replacement fund calculated at a certain rate on the capital value of the slave were extra costs which the employer of free labor did not have to assume, representing, therefore, a special and notable disadvantage in the case of slave labor. Such an assumption, however, was the reflection of imperfect economic analysis. When capitalization was accurately effected, the series of successive incomes as they became available

[17] Johann David Schoepf, *Travels in the Confederation* (Philadelphia, 1911), II, 148.

[18] Harrison A. Trexler, "Slavery in Missouri, 1804–1865," in Johns Hopkins University, *Studies in Historical and Political Science*, Series XXXII, No. 2 (Baltimore, 1914), 31–32.

[19] *Debow's Review*, XXV, 489.

[20] *Ibid.*, IV, 275; X, 241; XIV (advertisement); Jeffrey R. Brackett, "The Negro in Maryland; A Study of the Institution of Slavery" in Johns Hopkins University *Studies in Historical and Political Science*, extra vol. 6 (Baltimore, 1889), 91.

actually were equivalent to interest and replacement, for interest and replacement would have been allowed for in the relatively low value which the owner paid for the services of the slave capitalized on a terminable basis. In short, the process of capitalization obscures the fact that the so-called interest on investment and replacement fund are actually the surplus over cost of maintenance appropriable from the ownership of the slave.[21] Of course, in a process of valuation involving anticipation of the future, capitalized future income and the income actually realized are likely to involve serious discrepancies, not only in individual cases, but even at times over large areas. Mistakes occur in estimating uncertain future returns, many farmers do not figure carefully interest earned on their investment,[22] and individual operators made the services of slaves earn more through good management less through poor management than had been allowed for in the process of market valuation.

PRINCIPAL BASIS OF THE COMPETITIVE SUPERIORITY OF SLAVE LABOR

An understanding of the reasons for the competitive superiority of slave labor as compared with free labor in regions favorable to the commercial production of staples rests on a comparatively simple basis. In the New World, with its abundance of fertile land, labor, when employed with a reasonable degree of efficiency, could produce a volume of physical goods larger than the bare requisites of its subsistence from birth to death. The owner of the slave had legally appropriated his services for life, and therefore was in a position to appropriate the surplus above the requisites of subsistence. Of course, land, equipment, and supervision were necessary to employ this labor productively, but these requi-

[21] In discussing the rent of mines the present writer has previously discussed this point, that both the so-called rent and the royalty, or replacement fund, are parts of the same thing, namely, the economic rent, or appropriable surplus. Cf. "Rent Under the Assumption of Exhaustibility," in *Quarterly Journal of Economics*, XXIII, 466–490.

[22] Cf. [Nathaniel A. Ware], *Notes of Political Economy, As Applicable to the United States* (By a Southern Planter. New York, 1844), 102.

sites exist also in the employment of free labor. The physical surplus might disappear for a time on account of crop failure, and price fluctuations might also cause the surplus to vanish for short periods, but normally there was both a physical and a value surplus for the full lifetime of the slave, which was appropriable by reason of the institution of slavery.

It was this appropriable surplus that gave slave labor under plantation organization an irresistable ability to displace free labor, whether hired or engaged in production on family-sized farms. Substantially, the minimum level of competition in the case of slave labor was bare subsistence. The planter was able, if necessary, to produce at price levels which left little more than the expense of maintaining the slave. White labor could bid no lower. As a matter of fact, however, the basis of competition rarely reached so low a level. There were extensive areas of fertile land where white labor could find an outlet for its energies without coming into acute competition with slave labor. Where free white labor did come into direct competition with slave labor in the South there resulted the process of geographical segregation already pointed out. The possession of areas suitable to the marketing of products was of vital importance to the owner of slaves, for otherwise he could enjoy the surplus product of their labor only in the form of a food surplus, which it was impossible to consume, or in an excess of personal services. In competition for the locations favorable to commercial agriculture the planter was able to pay a portion of the annual value of the slave or its capitalized equivalent as a premium, if necessary, to outbid free labor in the acquisition of land.

RELATION OF THE ECONOMY OF SLAVE LABOR TO THE SUPPLY OF LAND

It is conceivable that had no restrictions been placed on the slave trade, the supply of slaves ultimately might have become so great that the value of their product would have barely exceeded the cost of maintaining slaves. This might have resulted either from the law of diminishing returns, due to scarcity of land, or to depression in the prices of products due to overproduction. In

his *Political Economy of Slavery,* Edmund Ruffin recognized the former possibility.[23] In his *Progress of the United States* (1843), Tucker concluded that slavery would tend to become economically moribund when the density of population reached sixty-six per square mile.[24]

Loria has developed a similar doctrine in a little different form, as follows: When land is abundant and the numbers of slaves relatively few, slavery as an economic institution is on the ascendant. The *peculium,* or allowance, of slaves will then be generous, but the masters will advance the value of the slave to the point where the slave is not able to accumulate enough out of his *peculium* to purchase his liberty. On the other hand as the supply of slaves becomes very great in relation to productive opportunities, the slave's *peculium* will become very niggardly, but values will fall in still greater proportion, and the slave will be able to purchase his freedom.[25]

Professor Loria's interpretation, however, appears to be merely an involved method of recognizing the conclusion that diminishing returns from increasing numbers might reduce the surplus above subsistence to a negligible point and render slave ownership a profitless responsibility. To speak of the masters raising the prices of slaves with the purpose of preventing them from pruchasing their freedom out of the savings from the *peculium* may serve the purposes of a philosophy of exploitation. The fact is that in the South the peculium itself was rarely more than bare subsistence. Increasing numbers and the pressure of land scarcity could have lowered it but little. On the other hand, the value of slaves was not subject to arbitrary action but reflected the surplus from the employment of slave labor as evaluated under conditions of market competition.

It is conceivable, of course, that the operation of the law of diminishing returns might be greatly postponed by the diversification of industry through development of industrialism. If

[23] *The Political Economy of Slavery* (Washington, 1857), 6.

[24] *Progress of the United States in Population and Wealth in Fifty Years* (New York, 1843), 112.

[25] *The Economic Synthesis* (London, 1914), 95–99.

this tendency had occurred it is probable that the emancipation of the slave would have resulted because freedom would have provided conditions more favorable to initiative and the exercise of intelligence. Under such conditions, as some economists have recognized, the slave's productivity would have become so much greater, when allowed to shift for himself, that he could have paid his master the equivalent of his earnings when employed as a slave and obtained enough above this to accumulate the means of purchasing his freedom.[26]

The belief, however, that in 1860 slavery in the South was on the point of being "strangled for lack of room to expand"[27] is a wholly mistaken interpretation of actual conditions. The plantation system was not seriously limited by scarcity of land. It had utilized only a small fraction of the available land area. The most fertile and easily available soils may have been occupied, but there was a vast area remaining, a considerable part of which has been brought into cultivation since 1860. At the time of the Civil War railways were rapidly opening up new fertile areas to plantation agriculture. Far from being a decrepit institution tottering toward a decline for lack of abundant land, the economic motives for the continuance of slavery, from the standpoint of the employers, were never so strong as in the years just preceding the Civil War.

The argument that slavery was becoming unprofitable just before the Civil War has been presented by Professor U. B. Phillips from another standpoint.[28] While recognizing clearly that the value of the slave was largely the result of a capitalization of net earnings, he argues that speculation had carried slave prices beyond the point at which they could be profitably employed except under the most favorable conditions. He points to the fact that cotton was very much lower in 1860 than it had been in the third and fourth decade, while the value of slaves was very

[26] Cf., for instance, Hadley, *op. cit.*, 35.

[27] Algie Martin Simons, *Social Forces in American History* (New York, 1911), 236, 262–263. Cf. E. R. A. Seligmann, *Principles of Economics*, 157–161.

[28] Cf. "The Economic Cost of Slaveholding in the Cotton Belt," in *Political Science Quarterly*, XX, 257–275.

much higher. It is easily possible, however, to derive a mistaken conclusion from this fact. Professor Phillips appears to defend the position that the movement toward over-capitalization was permanent, resulting in a steadily growing tendency for plantation agriculture to become unprofitable. Achille Loria also accepts and elaborates this interpretation.[29] The present writer does not agree with this conclusion. A temporary over-expansion of capital values in relation to net earnings, as a result of speculation, is at most only a temporary phenomenon. Expansion and contraction of slave prices occurred several times during the *ante-bellum* period, in relation to variations in the prices of the great Southern staple, cotton. Moreover, as compared with earlier periods, prices of cotton should be considered in relation to the fact that in the interval from 1794 to 1860 there was a considerable reduction in cost of producing cotton. It is not improbable, moreover, that slave prices in the earlier period had not completely risen to the point justified by the enormous profits which contemporary accounts describe; for slaves had not come to have the scarcity value later arising from restriction of the trade, whereas demand for cotton increased for a time very rapidly, giving rise to prices far in excess of even the high costs of production. There is no apparent reason why high capital values should be a permanent cause for unprofitable plantation economy. Had such a condition prevailed for a considerable period, affecting the profits of a great majority of those who were actively demanding slaves, this demand must ultimately have declined, and with it the excessive values. It must be remembered, however, that the active demand which tended to boost the prices of slaves came from those planters who were making large profits and who sought to expand their slaveholdings on the basis of these large profits.[30]

[29] *The Economic Synthesis*, 97.

[30] For contemporary accounts attesting the high profits made by planters, both in the earlier and in the later periods, see *Southern Agriculturist*, IV, 301; [George Rockingham Gilmer], *Sketches of Some of the First Settlers, of the Cherokees, and The Author* (New York, 1855), 165; Timothy Flint, *A Condensed Geography and History of the Western States, Or the Mississippi Valley* (Cincinnati, 1828), 506; Joseph Holt Ingraham, *The Sunny South* (Philadelphia, 1860), 298.

THE INFLUENCE AND SIGNIFICANCE OF INTER-REGIONAL COMPETITION

If competition had worked smoothly and slave labor had flowed readily to the points of most advantageous employment, as assumed in the Ricardian theory of rent, the rent-bearing land would have been the land of superior quality and location, and the return from the employment of slaves on such land would have tended to be the same as on the no-rent land, the rent merely measuring the difference in the gross product of an equal quantity of labor and equipment employed on the two grades of land.[31] In practice, however, the complete mobility assumed was not fulfilled. From time to time new areas were opened to settlement, containing lands superior to those occupied in areas of earlier settlement, the natural inferiority of which was being steadily intensified by deterioration. While the value of these new lands rose rapidly on account of the inflow of population, yet immigration was not rapid enough to cause land values to absorb all the differential in productivity as compared with the poorer lands in the older regions of settlement. Correspondingly, the rise in the level of value of slaves by reason of demands of the Southwestern market tended to depress the value of land in the older States.[32] On account of the retardation in the bidding up of values of the better lands commensurate with their full superiority, labor tended to earn in the newer areas a return that was considerably higher than it received in the older regions, handicapped as they were by impairment of fertility. For instance, about 1835 it was declared that planters in the Southwest could pay for negroes almost twice as much as the majority of Virginia planters could afford to give for employment on their plantations.[33]

The large differential in productivity stimulated the transfer of slave labor to the Southwest, either by sale or by migration. The compulsion came about through the fact that the newer regions were able to capitalize slave labor so high that the surplus earned

[31] Cf. Gibson, *op. cit.*, 194.
[32] *Farmers' Register*, III, 128.
[33] *Ibid.*, II, 763–764.

by the employment of slave labor in the regions of earlier settlement would not earn a reasonable interest on these higher capital values. It was in this sense that the employment of slave labor in general farming was frequently unprofitable. In the same sense, it was unprofitable when employed in the production of cotton in some of the older cotton-producing regions. Yet, slave labor in the older regions—probably even in New England—was able to earn a physical and a value surplus above cost of maintenance, and had it not been for the competition of the new lands of the West, it would have continued profitable in the older regions as long as it was possible to average something above the cost of subsistence.

It was the fact that slavery tended to be profitable in the new regions, while unprofitable in regions in the wake of expansion, that resulted so generally in the mistaken conclusions that slavery can thrive only on the basis of geographical expansion and a migratory economy, that slavery is adapted only to extensive agriculture, that it inevitably results in soil exhaustion, and that it cannot be profitable in general farming; none of which conclusions appear to be justified in the absolute sense in which they have been asserted.

It will be apparent also that the idea that the interest on the capital value of slaves was a necessary element in cost of production is true only in the sense that, being earned by one region or industry, it must be paid by other regions and industries in order to command the services of slave labor. In a general sense, however, this surplus was not a necessary charge. If the prices of all Southern products had fallen so low that it was impossible in any industry or region to earn more than a few dollars a year as the net return for slave labor, it would still have been profitable to employ it. This is true not only of that part of the surplus designated as "interest," but also of the so-called "depreciation."[34]

In the above discussion the comparative surpluses from employment of slave labor were considered as though uniform for all producers. In fact, there were planters even in the older regions

[34] For a discussion of the analogous problem of whether both rent and royalty are supluses in the case of mines, cf. Gray, *op. cit.*

who, through good management and organization, were able to make a profit on the high capital values for slaves resulting from Western competition. The same efficiency, however, would probably have resulted in larger profits under the favorabe conditions of newer regions. Some of these more efficient planters bought up the lands of neighbors who were willing to sell cheap in order to emigrate.[35]

[35] *Southern Cultivator*, VIII, 180; *American Agriculturist*, III, 118; *DeBow's Review*, XIV, 508; XIX, 727.

THE HISTORY OF AMERICAN WHEAT IMPROVEMENT

By Carleton R. Ball[1]

THE BACKGROUND

The origin and early history of wheat are unknown. When, where and by whom it was domesticated must remain forever an unsolved mystery. Its wild ancestors, like those of corn, never have been discovered. Its culture and utilization by man extend backward in time far beyond the earliest records of human history. Wheat kernels of approximately modern types have been found in the remains of the Swiss lake-dwellers, the tombs of the Egyptian Pharaohs, and the buried cities of the Mesopotamian civilizations. The most outstanding contribution to the improvement of wheat was its domestication by primitive and prehistoric man. No scientific achievement with wheat in our own time equals this in its importance to the human race.

At the beginning of its known history wheat was already differentiated into some of the subspecies now recognized. Varieties and forms seem to have existed from earliest historic times. With the ceaseless mixing and migrations of tribes and nations, these forms must have been constantly and widely distributed to new geographic environments. In this way the opportunity for the natural crossing of varieties, and for the action of the yet little-known factors causing mutation, has steadily increased through the ages. Man has perpetuated these forms as they have arisen in nature.

Probably all conscious efforts at wheat improvement have had one or more of four primary objects. These are: (1) im-

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proved yield per unit of area; (2) improved inherent quality of the kernel, in size, accessibility, texture, and food value; (3) improved adaptation of the plant to its physical and physiological environment; and (4) protection of the crop from diseases and pests. Improvement in adaptation has been directed chiefly toward eliminating undesirable characters, or developing resistance to unfavorable conditions. This, together with other means of protecting from diseases and pests, usually has resulted directly in improved yield and quality also.

At no stage of progress has any one person been able to glimpse more than a small portion of the whole problem, or to see far down the narrow path he was following. Certainly no one claims to do so now. As in mountain climbing, each forward step discloses new and distant horizons.

Wheat had been cultivated rather extensively for one to two thousand years or more in the various countries from which came the explorers and colonizers of America. Different subspecies and large numbers of different varieties were available and much was known of the ways of growing the crop under different sets of conditions.

In northern Europe, the varieties of the common or bread wheat (*Triticum sativum vulgare* Vill.) were most commonly grown. In southern Europe, and especially in dry-land Spain, the varieties of club wheat (*T. sativum compactum* Host) were more generally used. Both contributed largely to the wheat industry of the United States, as we shall see. The history of wheat introduction, culture, and improvement in Mexico and in Canada is so intimately interwoven with that in our own country that some attention must be given to agricultural events in those two countries in the course of this paper.

PERIODS IN AMERICAN WHEAT HISTORY

The history of wheat growing and improvement in America may be roughly divided into six successive periods. There usually is overlapping of periods in history, and therefore the limits must be arbitrarily fixed. The six periods outlined below each had its own problems and series of events which markedly influenced the

trends of wheat improvement and production. These periods may be designated as follows: (1) The pre-colonial period, 16th century; (2) The early colonial period, 17th century; (3) The later colonial period, 18th century; (4) The period of national expansion, 1801–1860; (5) The period of education, investigation, and improvement, 1861–1900; (6) The period of research, 1901–1930.

1. THE PRE-COLONIAL PERIOD, 16TH CENTURY

Wheat was first introduced from Spain to the West Indies by Columbus in 1494. From there it was promptly carried to Mexico,[2] and thence to western South America, with the advance of conquest: Both these areas were well adapted to the culture of drought-resisting wheats and a large commercial production developed.

This was of great importance to future wheat production and improvement in the western United States. It brought to America the best wheats of Spain, both club and common, tested them under a wide range of conditions, and developed those best suited to hot dry climates. When these wheats reached California, therefore, about 1770 or soon thereafter,[3] they were already adapted to the conditions and provided a good basis for the work of American improvers, and some are still widely grown on the Pacific Coast.

On the north, both English and French wheats were tested at different points on the North Atlantic Coast by explorers and fishermen but apparently no permanent culture resulted from introductions earlier than those to Acadia early in the next century.

[2] Arthur P. Whitaker, "The Spanish Contribution to American Agriculture," in *Agricultural History*, 3 (1): 3–14. January, 1929.

No attempt has been made to cite the many well known sources for most of the individual facts given. The footnote references represent either foundation, contributions necessary to perspective, or recent special papers.

[3] George W. Hendry and Margaret P. Kelly, "The Plant Content of Adobe Bricks," in *California Historical Society Quarterly*, 4 (4): 361–373. December, 1925.

2. THE EARLY COLONIAL PERIOD, 17TH CENTURY

From the standpoint of wheat introduction and future improvement it was fortunate that the United States was settled as a series of colonies, and over a long period of years. It was of decided advantage, also, that the colonists came not only from several distinct shires of England itself, but from several different countries of Europe. These facts insured that many different kinds of wheat were brought here with successive immigrations, thus guaranteeing the best possible foundation for making variations in adaptation apparent and allowing crossing and variation to occur. All of these processes, immigration, introduction, migration, mixing, and crossing, have continued to our day.

Wheat was tried by Gosnold in Buzzards Bay in 1602; it was grown in the Jamestown Colony as early as 1611, and at Plymouth soon after 1621. Fresh introductions from England were made by the additional colonies planted later in New England (1628 and onwards) and in Maryland (1634). Wheats from Holland and Sweden came with their colonists to New York (1622 or 1626), New Jersey (1622), and Delaware (1638), good specimens from New Netherlands being taken back to Holland in 1626. The planting of later English colonies in the Carolinas (1663 and 1670) and Pennsylvania (1682) continued the introduction of English wheats to the end of the century. The founding of Georgia (1732) carried colonial introduction into the next period.

Improvement probably went little farther during this period than the attempt to find varieties best adapted to the unfavorable conditions. Neither the soils nor the climate of most of the Atlantic coastal plain are well suited to the culture of wheat. Wheat growing languished in the early colonies because corn not only was better adapted but because it was more easily planted and harvested under pioneer conditions and with hand labor and primitive implements.

Protection of the wheat crop against diseases received some public attention during this period. In 1650 (possibly 1625) wheat was first steeped and limed in England, to prevent smut. The practice may have been used in America before the end of the

century. In 1660, laws were enacted at Rouen, France, to compel the eradication of the European barberry in order to reduce the increasing damage from stem rust. It is quite possible that the abundant French immigration encouraged by the English government during these years may have brought that bit of information to our farmers, though no legislative action resulted for another 100 years.

Destructive epidemics of "blast" and "mildew" in New England in 1663 are discussed in an old manuscript diary quoted by Flint.[4] These general terms may have indicated any or all of the diseases now known as smut, rust, or scab, and possibly others. At any rate, the epidemics recurred and interest in New England wheat growing declined somewhat after that time.

3. THE LATER COLONIAL PERIOD, 18TH CENTURY

So far as wheat was concerned, this century was chiefly a period of preparation for the amazing progress of the next. The first half of the 18th century was occupied with steady growth and development. Georgia, the last Atlantic Coast colony, was founded in 1732. Increasing population settled the better wheat soils of the Applachian Piedmont but did not overflow perceptibly into the interior.

The second half of the century was marked by the development of extensive French settlements in what is now Illinois and adjacent States, wherein wheat was a highly important crop. Earlier introductions of French wheats to the St. Lawrence Valley were the sources of the Illinois industry, which, in turn, furnished some of the wheats for the later agricultural development of the area by English settlers.

Some progress in protecting wheat from disease was made in the last half of the century. Massachusetts farmers had long observed that in many seasons the wheats growing near their numerous hedge fences of European barberry were severely injured by stem rust. As early as 1726, Connecticut passed a law granting

[4] Charles L. Flint, "A Hundred Years' Progress of American Agriculture," in U. S. Dept. Agr., *Report*, 1872: 274–304. 1874.

power to the town meetings to take steps to eradicate the bushes. Massachusetts and Rhode Island passed similar legislation about thirty years later. This was about 100 years *after* the farmers of Rouen, France, had done the same thing (1660), and 100 years *before* De Bary proved the relationship between the rust and barberry (1865).

Something is known of the wheat varieties grown in the latter part of this period. Red Lammas and White Lammas are two varieties grown widely in England during the 17th century, when America was being colonized. Red Lammas was grown in Virginia long prior to the Revolution. It survives to this day in Red May, known also under some score of other names, and still grown on 400,000 acres in the East in 1924. Red Chaff, a white wheat, now known as Goldcoin, dates back at least to 1798.

In the West, Sonora, a peculiar Spanish wheat, now grown sparingly around Tulare Lake, in California, is known to have been grown in Sonora, Mexico, since 1770, and by the Pima and Yuma Indians of Arizona since the early years of the 19th century. Hendry and Kelly[5] found the remains of two club and of two common wheats, including the present-day Little Club, in the adobe bricks of Spanish missions in California dating from 1770 to 1800, and a third club variety in one mission dating from about 1824. Doubtless many of our other present-day wheats have as ancient a lineage if only the facts could be known.

4. THE PERIOD OF NATIONAL EXPANSION, 1801–1860

This perod was characterized by remarkable advances in many lines. Enormous territorial expansion extended our boundaries westward to the Pacific. Large new areas, with widely different conditions of soil and climate, were opened to the use of the wheat farmer. The development of means of rapid communication and of newspapers and schools greatly influenced the interchange of ideas and materials. Better milling machinery and processes, and the increased prosperity of the people, stimulated a demand for more and better wheat flour and therefore for better wheat.

[5] Hendry and Kelly, *op. cit.*

Nor was governmental interest in the betterment of agriculture lacking in this period. A committee on agriculture was created in the House of Representatives in 1820, and in the Senate in 1825. An approporiation of $1,000 was made in 1839 "for the collection of agricultural statistics, and for other agricultural purposes." In 1836 the Commissioner of Patents undertook unofficially to receive and distribute new and valuable seeds to the farmers of the country, and in his report to Congress he urged the creation of an official agency for carrying on this service.

Agriculturally the period was marked by the development of reaping machinery and the improvement and more general use of seeding and tilling machinery. Probably more important still were the development of shows and fairs, the founding of agricultural papers, and the organization of agricultural and horticultural societies. All these gave the farmer an opportunity to exchange ideas and seeds and to see the products of other farmers. Thus he was furnished with a direct incentive to produce something superior himself, certain that he would have a chance to display it for the approval of his fellow craftsmen. These agricultural events certainly were no less important and far reaching in their results than the political and commercial achievements just enumerated.

One of the quickest and surest means of improving American wheat seemed to lie in the introduction of new varieties from foreign countries, especially as so much new and different territory was being settled in our own. American consular and naval officers abroad, following the example of Franklin before the Revolution, had been forwarding agricultural material from time to time. They were now asked to do so systematically and intensively. One result was the introduction of large numbers of wheat varieties from many different countries of the world. An increasing immigration from Central Europe doubtless brought other wheats.

Some of the varieties then introduced became of large importance in succeeding years, both commercially and as breeding stocks, and some of them still are grown extensively in this country. A few examples must suffice.

Some valuable introductions

Mediterranean, sent from some port on the sea of that name, was received in 1819 and soon became widely grown. Just 100 years later it occupied 2,770,000 acres in our war-time expansion of area, and in 1924 it still was grown on 600,000 acres, or more than 1 per cent of our wheat acreage.

Purplestraw, from a source now unknown, dates at least from 1822, and was still grown on 116,000 acres in the Southwest in 1924. Java, or Siberian, has been known here since 1837; Gold Drop arrived from England before 1843, and China, from the land of that name, about 1845, and is still grown.

White Australian (Pacific Bluestem), a white wheat, developed from the White Lammas of England, reached California from Australia at least as early as 1850. It was a much better bread wheat than the club wheat grown on the Pacific Coast then and since and helped greatly to raise the quality of western wheat. It was still grown on 370,000 acres west of the Rockies in 1924. White Winter, almost certainly an English wheat, was widely grown in the Willamette Valley of Oregon by 1855, and is still found there.

Improved wheats developed by selection

Before the end of this period the interest of the better farmers in improved wheat varieties had been fully aroused. Some of the more observing began to make selections from the admixtures, mutants, or natural hydrids occurring in their fields.

One of the earliest selections of which we have record is Zimmerman, an admixture selected by Henry Zimmerman, of Frederick, Md., in 1837. Both a red and a white wheat soon became extensively grown under this name and it is not known now which was the original. The red one is still found in cultivation.

Undoubtedly the one of most importance to the United States was the famous Red Fife, selected as a single plant of spring wheat from a spring sowing of what proved to be winter wheat. The selection was made by David Fife, of Ontario, Canada, in 1842. The wheat came from a shipload which went from the port of

Danzig to a mill in Glasgow, from whence a small packet was sent to Fife. This was the first truly hard red spring wheat known on this continent. It reached the United States by way of Wisconsin in 1860 and eventually became the basis of the great Minneapolis flour industry, which surely should have been honor enough.

Later, however, it became the male parent of the still more famous Marquis wheat, the outstanding hard red spring wheat of the world.

Some others developed by selection in this period, and still grown commercially, are Soule, now called Goldcoin (New York, 1853), and Penquite (Ohio, 1857).

Other methods of improvement

During this period wheat in the Eastern States suffered severe injury from the attacks of the so-called Hessian fly. The farmers thoroughly believed, and perhaps correctly, that it was introduced to this country in the straw brought over with the horses of the Hessian soldiers who formed part of the British army during the Revolutionary War. The Mediterranean wheat introduced in 1819 was found to be somewhat resistant to the attacks of this insect and therefore was strongly recommended for growing in the infested area. This gave rise to a protracted controversy.

The demand of those days was for a white wheat, because the milling methods did not permit the complete separation of the bran from the flour, and red bran naturally discolored the flour more than white bran. Many red wheats were in use, however, but they mostly were soft wheats. Mediterranean was a semi-hard wheat (they called it hard), and therefore more objectionable because the necessary milling procedure ground its bran still finer and made it more difficult to remove. For fully 40 years the controversy raged between the millers and the white-flour users, on the one hand, and the fly-injured farmers, on the other. As in other cases, the wheat, though despised and maligned, steadily increased in acreage and importance.

Wheat quality also was improved during this period through the growing use of better plows and other tillage implements, which prepared a better seedbed in the clay soils of the new wheat

belt. This promoted more uniform germination, growth, and ripening. The use of commercial fertilizers on some of the badly worn soils of the older colonies also had some effect. Finally, the more general use of reaping machines enabled the farmer to harvest more promptly after ripening and thus prevent damage by sun and rain.

The publication by John H. Klippart[6] shows the increasing interest in wheat. He describes the wheats grown in Ohio in 1857, includes much historical information, and attempts to group them in a classified order.

This period of activity in wheat improvement was brought to a fitting close by the publication of Darwin's Origin of Species, in 1859. This epoch-making work focused wide public interest on plant improvement and had weighty influence on the advances recorded in the next period.

5. PERIOD OF EDUCATION, INVESTIGATION, AND IMPROVEMENT 1861–1900

This period, like the preceding, was characterized by several outstanding events profoundly influencing the progress of agriculture in general and wheat improvement in particular.

In the first place, the close of the Civil War, in 1865, released more than a million young men not afraid of privation or hard work, but somewhat impatient of convention and restraint. The frontier, with its homesteads, offered opportunity for their energies. The immediate result was the rapid settling of large areas of level prairie and plains where large scale wheat farming was possible and profitable. This competition with the older farms of the East made it necessary for the latter to have varieties producing better yields per acre and led to increased interest in improvement. The soft eastern wheats were not fully adapted to the dry lands over which wheat culture slowly spread, which created a demand for drought resisting varieties.

In the second place, the Morrill Act, creating the land-grant sys-

[6] "An Essay on the Origin, Growth, Diseases, Varieties, &c., of the Wheat Plant," in Ohio State Board of Agriculture, *Annual Report*, 1857: 562–816. Columbus, 1858.

tem of agricultural colleges, was passed in 1862. Not long thereafter these educational institutions began to affect our knowledge of crops, livestock, and soils, and the relations between them. This speedily stimulated a desire for their betterment.

Still more significant and influential was the creation of the system of agricultural experiment stations by the Hatch Act of 1887. This led rapidly to investigations on an increasing scale and over the whole country. Wheat, because of its widespread production, and of the importance and value of the crop, received a proportionate share of attention. Coincidently the United States Department of Agriculture expanded its activities to include farm crops.

Of immense importance also were the successive productions of the self-rake reaper; the Marsh harvester, cutting the labor of binding in two; the wire binder, and finally, the long sought twine binder, the appearance of which was delayed by the difficulty of perfecting the mechanism called the knotter, which ties the knot in the band around the sheaf.

Other inventions of almost equally great, though not as direct, importance to wheat improvement were, first, the development of the purifier which enabled the first satisfactory separation of the bran from the flour in middlings, and secondly, the invention of the roller mill to replace the clumsy and not finely adjustable stone burrs for the grinding of wheat into flour. The first purifier in this country was installed in Minneapolis in 1870, and the first completely equipped roller mill in the same city in 1878. This second invention enabled the grinding of hard wheats and so made profitable the growing of two new classes of high-quality wheats. These were the hard red spring (introduced 1860) in the Upper Mississippi Valley and the hard red winter wheats (introduced 1873) in the Central Mississippi Valley.

Under the triple stimulus of education, invention, and economic need, the improvement of wheat varieties was undertaken by many individual farmers. The method of pure-line selection was still followed exclusively at first but soon the method of hybridization was taken up because it offered the possibility of combining the desirable characters of two or more wheats and also afforded greater variation as a basis for selection.

Pure-line selection

The production of new varieties by pure-line selection was begun by farmers, as noted previously, in the latter part of the preceding period. It was continued throughout the remainder of the 19th century and even into the 20th. We know the names and selectors of more than a score of varieties which reached the stage of considerable commercial production and there must have been many more which fell by the wayside. It is possible to list here only the most important.

Fultz is a beardless soft red winter wheat descended from a plant occurring as a mixture in a field of Lancaster (Mediterranean) and selected by Abraham Fultz of Mifflin, Pa., in 1862. This wheat was widely distributed in the central part of the eastern wheat belt. In 1919 it was grown on 4,800,000 acres of the greatly expanded war wheat area, while in 1924 it still occupied 1,787,000 acres or about 3 per cent of our total wheat acreage. Some new selections from Fultz occupied nearly another million acres in the latter year.

Rudy, started from a single plant selected by M. Rudy in Ohio, in 1871, and was still grown on 250,000 acres in 1924. Currell, or Currell Prolific, started from a plant selected in a field of Fultz by W. E. Currell of Virginia, in 1881, and was still grown on 260,000 acres in 1924. Harvest Queen originated from a plant selection by E. S. Marshall in Kansas in 1895, and was grown on 400,000 acres in the Middle West in 1924 and on over 1,000,000 acres in 1919. It is very winter hardy but very susceptible to flag-smut and rosette.

Wellman, Power, and Rysting are selections of Red Fife made or developed by farmers in Minnesota and North Dakota between 1884 and 1892. Haynes Bluestem is a similar selection from Bluestem made in North Dakota about 1895. All these were important contributions before the Fifes and Bluestems were displaced by Marquis.

At the Minnesota Agricultural Experiment Station, Prof. Willet M. Hays (1893–1905), previously at the North Dakota Station (1892–93), collected large numbers of spring wheat samples,

developed the centgener system of testing them, and isolated some selections of Fife (Minn. 163), Blue-stem (Minn. 169), and Preston (Minn. 188) which became commercially grown.

Improvement by hybridization

The production of commercial varieties by selection from the progeny of artificial crosses dates from about 1870. For the most part is has been the work of men who have given practically full time to the work through a long series of years. Some of the men who have had large success were plant-breeding farmers, whereas others have been connected with agricultural colleges or experiment stations. Only one variety of large value was originated in this period by a farmer who did not specialize in this work, so far as is known.

In 1886, S. M. Schindel of Hagerstown, Md., crossed Fultz and Lancaster (synonymous with Mediterranean) and named his selection Fulcaster. It proved to be a high yielder of good quality, and rather widely adapted, as were both the parents. It has the white glumes and kernel quality of the Fultz and the awns and general resistance of Mediterranean. In 1924 it occupied 1,800,000 acres in the eastern half of the United States. It comprised 17 per cent of the acreage of soft red winter wheat and 3.5 per cent of the total wheat acreage of the country. Mr. Schindel, however, was not the first farmer to produce wheat crosses.

The making of wheat hybrids in this country apparently began with Cyrus G. Pringle, who later became a well known botanical collector in the United States and Mexico. His work with wheat was done at Charlotte, Vt., where he released at least four white varieties, of good quality, between 1870 and 1877. His first variety, Champlain, was brought out in 1870; his second, Defiance, in 1871, and a fourth, Surprise, in 1877. Oddly enough, all these Vermont wheats were distributed chiefly in the far West, where they still are grown commercially to some extent. Defiance, probably still heterozygous when distributed, has been reselected by others and now comprises three commercial varieties which occupied some 40,000 acres in 1924. His Surprise was distributed by Le Duc, United States Commissioner of Agricul-

ture (1877–1881), and still was grown on some 17,000 acres, in 1924, while Dicklow, a selection from it, was found on 116,000 acres in 1924.

Mr. Elbert S. Carman, editor of the Rural New Yorker, began his work in wheat hybridization probably about 1875, and made numerous crosses. Two of his hybrids are still in culture in New York and adjacent States. His Rural New Yorker No. 6 was reported to have been produced in 1883 by crossing wheat and rye and apparently was first sold commercially in 1894. Rural New Yorker No. 57 descended from parents which themselves were both hybrids. It also was first offered by a seed firm in 1894 and was said to be the "result of upwards of 20 years of thoroughly scientific crossing and careful selection at the hands of Mr. E. S. Carman."

Mr. A. N. Jones, a farmer who lived at Newark, Wayne Co., N. Y., until about 1890, and at LeRoy, Genesee Co., therafter, made a most remarkable record as a wheat breeder. He produced at least 15 hybrid varieties, and probably several more, which were distributed commercially in the 20 years between 1886 and 1906. Unlike Pringle and Blount, he worked with both white and red wheats, and unlike them again his wheats were distributed in the Northeastern States. Five of them were still grown in 1919, on a combined area of about 1,800,000 acres. In 1924, four of them were still grown. Red Wave occupied about 435,000 acres, in the eastern States, in 1924, and Jones Fife about 210,000 acres, mostly in the Pacific Northwest, in the same year. Jones seemingly was the first to practice composite crossing, his Early Genesee Giant, put out in 1893, being the product of 8 successive crosses.

Professor A. E. Blount, working during the '80's at the Colorado Agricultural College before the experiment station was founded, produced more than a dozen wheat hybrids which became commercial. Living in a mining State, he adopted the quaint conceit of naming his hybrids for various native rocks and minerals, among them being Amethyst, Felspar, Granite, Gypsum, Hornblende, Quartz, Ruby, and Tourmaline. Several of his wheats were sent to Farrer in New South Wales and there entered into

the parentage of some of Farrer's best hybrids. For instance, Gypsum, known in Australia as Blount's Lambrigg, is an ancestor of Bobs and Bunyip, whereas Hornblende enters into Bunyip and John Brown. As Bobs and Bunyip both are grown in the United States, this may be taken as an example of casting our bread upon the waters and having it return to us.

The need for the improvement of the quality of wheat varieties was clearly seen by several of the newly created State agricultural experiment stations and comparable Federal agencies in the last decade of this period and they were able to make a beginning on the problem. Willet M. Hays[7] made some crosses of hard red spring wheats in Minnesota but no commercial varieties ever resulted. Spillman, who was at the Washington station from 1899 to 1902, made several crosses between club and common wheats in 1899. From these he and his successors developed several commercially-grown club wheats, to be mentioned in the history of the next period.

In Canada, Dr. William Saunders, and his sons, Drs. A. P. and Charles E. Saunders, working at the Central (Dominion) station and several substations, began crossing wheats as early as 1888. Crosses made in the years named resulted in the subsequent production of the following commercial varities: Huron, Preston, and Stanley (1888), and the famous Marquis (1892). All of these later became grown commercially in the United States. Several others were produced by the Saunders family and some of them became commercial or were used in producing still other hybrids.

In New South Wales, Australia, William J. Farrer began his efforts to improve the quality, drought resistance, rust resistance, etc., by crossing wheats,[8] as early as 1886 and continued until 1906. His work is of importance to us because of the large number of commercial varieties produced, because some of Blount's hybrids were used as parents by him, and because several of his own hybrids are now commercial in the United States.

[7] Willet M. Hays, Plant Breeding, U. S. Dept. Agr., Div. Vegetable Physiology, and Pathology, *Bulletin 29*. Washington, 1901. In this connection see p. 56–57.

[8] F. B. Guthrie, *William J. Farrer, and the Results of His Work*, as New South Wales, Dept. Agr., *Science Bulletin 22*. Sydney, 1922.

Introductions of hard wheats

Introductions of high quality wheats made during this period were of tremendous importance to wheat improvement in this country. They included two new commercial classes, hard red winter and durum wheats. If we include the introduction of Red Fife from Canada, in 1860, as belonging to this period, in which all its distribution took place, a third new class is added, namely, hard red spring, the most valuable of all for quality. It is significant that the introduction and distribution of the hard spring wheats took place before the general introduction of the roller mill and the purifier which made their efficient use possible. For this reason they were discounted and discouraged at first.

The first introduction of the hard red winter wheats was made by German Mennonites emigrating from southern Russia. They settled in 1873 in central Kansas where this class of wheat fortunately is peculiarly adapted. They may have left some of these in Illinois where they stopped for a time en route. Michigan millers seeking wheats of better quality and greater winter hardiness introduced such Hungarian varieties as Pesterbodon (semi-hard) and Theiss about 1892.

The Kansas hard wheats attracted only local attention until Carleton recognized their resistance to drought and rust in the 90's. So impressed was he with their possibilities that he was sent to Russia in 1900 to get superior varieties. He brought back and distributed Crimean, Kharkov, Beloglina and others. These wheats now occupy more than 40 per cent of our total acreage of wheat.

Durum wheats had been introduced at various times in the preceding period but had failed to become commercial. Russian settlers in North Dakota established their commercial culture. In 1900 Carleton introduced quantities of Arnautka, Kubanka, and other varieties from southern Russia and also purchased Arnautka in North Dakota and distributed it. From these two sources has come our present durum industry.

Other methods of improvement

The newly-established experiment stations took up several varied problems influencing wheat production and improvement. Among these were varietal adaptation, rates and dates of seeding, values of large and small seed, methods of seedbed preparation, rotation effects, and the influence of fertilizers.

On the crop-protection side, the study of the control of stinking smut by hot water and other chemicals was begun by Swingle as early as 1889 and continued by Kellerman and Swingle, and by Arthur. The study of resistance to rusts, especially stem rust, was begun by Mark Alfred Carleton[9] at about the same time. He assembled some 1,000 varieties and grew them in Maryland in 1895 and many of them in Kansas in 1896 and 1897, making careful observations on their comparative rust resistance and other characters. The results of these experiments were so suggestive that Carleton was sent to Europe to get wheats resistant to rust and cold.

The gradual development of the system of commercial grades for wheat began early in this period. In recent years it has played an increasing part in recognizing the class and quality of wheat in commercial channels. This was extremely important as we progressed nationally from only soft wheats to three different classes of hard wheat as the basis for our milling and export wheat industry.

This period saw also the beginning of investigation of the chemical and physiological basis for quality in wheat and so paved the way for prompt action when the laws of heredity were discovered. Some pioneer work was done by Kedzie in Michigan, Snyder in Minnesota, and Teller in Arkansas, on the time and sequence of protein and starch deposition in the wheat kernel.

As the close of the last period was marked by the publication of Darwin's Origin of Species, so the last year of this period (1900) was made epochal by the publication of the independent redis-

[9] Thomas Lyttleton Lyon, The Basis for the Improvement of American Wheats, U. S. Dept. Agr., Div. Vegetable Physiology, and Pathology, *Bulletin 24*, Washington, 1900.

covery of Mendel's laws of heredity by DeVries, Correns, and Tschermak, and by the appearance of DeVries' mutation theory. The stage was set for the marvelous progress of the 20th century.

THE RESEARCH AND GENETIC PERIOD, 1901–1930

This period is characterized by the diversity and intensity of the research affecting the improvement of wheat. Ushered in by the rediscovery of the simpler laws of Mendelian inheritance (lost since Mendel's publication in 1866), the greatest progress in fundamental research has been made in that field, as regards both the wheat plant and its fungus parasites. As the theme of this paper is improvement, the direct result of work in that line will be presented first.

Four foundation papers

Just at the opening of this period three papers appeared which summarized existing knowledge and laid the foundations of future progress in introduction, selection, breeding, adaptation, and the physiological and biochemical study of the influence of environment on production and quality.

The first paper, actually issued in December, 1900, was by Carleton[10] and contains a broad discussion of the characteristics and wheat needs of the several wheat districts of the United States, and a full analysis of the characters of the different major groups of wheats as a basis for supplying these needs. He publishes in tabular form the results of his 3-year tests of about 1,000 varieties with special reference to quality of kernel and resistance to rusts, cold, and drought. Tribute is paid to the work of Pringle, Blount, Jones, Schindel, and Hays in this country, the Saunders family in Canada, and Farrer in Australia, as well as to various workers in Europe.

The second paper, in 1901, was by Hays[11] and presents a detailed account of the principles and technique of plant breeding, as then understood, with special reference to the selection and breeding of wheat, with which the author chiefly was engaged.

[10] *Ibid.*

[11] Hays, *op. cit.*

The centgener system of developing pure-line selections is described in detail and the histories of several Minnesota selections are given. Curiously enough, while citing the work of many improvers of animals and plants, in this and other countries, the paper omits any mention of the work of the well known American, Canadian, or Australian improvers of wheat.

In the third paper, Thomas Lyttleton Lyon[12] reviewed fully the investigations in this country and abroad on the relationship of many environmental factors to the content and quality of the wheat kernel, and, conversely, the influence of certain characteristics of the seed wheat on the quantity and quality of the resulting crop. He then presents the results of his own research, with associates, into these subjects. He concludes that certain qualities of the wheat kernel are hereditary and that "There is a tendency for plants possessing any of these qualities in an extreme degree to produce progeny in which the same qualities approach more nearly to the average, but certain exceptional plants may transmit the same or more extreme qualities" (p. 120).

The fourth of the foundation contributions was the assembling, describing, and classifying of all commercial American wheat varieties, begun by Ball and Clark in 1914. Published in 1922,[13] it gave agronomists and geneticists the first comprehensive knowledge of the habits and characteristics of the diverse wheat materials on which they were working.

It presented also, by map graphs, the geographic distribution of all important varieties. This information was supplemented by a second paper, by Clark and associates,[14] presenting similar data on distribution in 1924, and including several new varieties.

Introduction, selection, and hybridization

During the previous period grades and then classes of wheat were increasingly differentiated commercially. This movement was

[12] Mark Alfred Carleton, Improving the Quality of Wheat, U. S. Dept. Agr., Bur. Plant Industry, *Bulletin 78*. Washington, 1905.

[13] J. Allen Clark, John H. Martin, and Carleton R. Ball, Classification of American Wheat Varieties, U. S. Dept. Agr., *Bulletin 1074*. Washington, 1922.

[14] J. Allen Clark, John H. Martin, Karl S. Quisenberry, John R. Hooker, C. E. Leighty, and Chester N. Du Bois, Distribution of the Classes and Varieties of Wheat in the United States, U. S. Dept. Agr., *Bulletin 1498*. Washington, 1929.

intensified by the United States Grain Standards Act of 1916. For these reasons, improvement will be discussed here by wheat classes, rather than by methods as before.

Soft red winter wheats. These, with the white wheats, represent our oldest wheat culture and are still grown extensively in the eastern half of the country because of high values for pastry flour uses and for export. The two leading varieties, Fultz and Fulcaster, as well as Mediterranean and others, have been used by the experiment stations in producing, by selection or crossing, several new varieties of high yield and quality, and possessing resistance to lodging, cold, smuts, rusts, or other unfavorable condition.

Among the results are Trumbull, Portage, Gladden, Fulhio, Nabob, and Ohio 9920, of the Ohio station, and occupying probably at least a million acres in 1928; Nittany of the Pennsylvania station, grown on a quarter million acres in 1924; Red Rock, occupying 340,000 acres in 1924, and Berkeley Rock, from the Michigan station; Purkof, reported on 500,000 acres in 1927, by the Indiana station; Forward, of the New York station, occupying much of the wheat area in that State, and Denton, of the Texas station.

White wheats. Once the dominant sorts, the white wheats gave way to red wheats only as milling processes improved. They still are important in the Great Lakes area and the Pacific Coast region.

The club wheats, grown in the Far West since early Spanish days, were greatly improved by Spillman and his successors from 1899 to 1908 through the production of Hybrid 60, Hybrid 63, Hybrid 143, and Hybrid 128. The latter was grown on 416,000 acres in 1924, in spite of competition with the improved common wheats discussed below. Dicklow, selected by a Utah farmer, was growing on 115,000 acres in 1924. The original white wheats were soft but some relatively hard varieties have been introduced and the industry greatly benefited. Baart and the Federation wheats (Federation, Hard Federation, and White Federation) introduced by the U. S. Department of Agriculture from Australia occupy probably more than a million acres now in the Pacific

Northwest. Of these, Baart, Hard Federation, and White Federation are classed as hard white wheats.

Hard red winter wheats. Of Russian origin, the relative resistance of these wheats to cold, drought, and rust was noted by Carleton in the 90's. Large quantities brought by him from Russia in 1900 were widely distributed and grown in the Great Plains area. From the Crimean variety, the Kansas station selected Kanred, grown in 1924 on some 4,000,000 acres. Blackhull, selected by a Kansas farmer, occupied 1,500,000 acres in that year. Other selections are Ilred in Illinois, Iobred in Iowa, Bacska in Wisconsin, and Nebr. No. 60 in Nebraska. Hybrid varieties produced by crossing and selection, some coöperatively, are Michikoff by the Indiana station, Minturki in Minnesota, Ridit in Washington, and Newturk in Montana. Together these new varieties occupy some hundreds of thousands of acres.

Production of the hard red winter wheats extends from Indiana to the Pacific Northwest, and occupies more than 21,000,000 acres, or 41 per cent of the total wheat acreage of the country. They are a monument to the farsightedness of Carleton[15] in the triple field of agronomy, pathology, and breeding.

Hard red spring wheats. Fife wheat, originated by selection in Ontario in 1842, reached the United States in 1860, and, with the Bluestems, became the basis of the Minneapolis milling industry. In 1892 it became one parent of the cross from which Marquis was developed by Dr. C. E. Saunders in Canada. Introduced into the United States in 1912, Marquis replaced many varieties and, in 1924, occupied nearly 10,000,000 acres in the upper Mississippi Valley, or about 85 per cent of the hard spring area and 19 per cent of the total area.

Marquis, though early, is rust susceptible, and as European barberries caused increasing stem-rust epidemics, efforts to produce resistant or escaping varieties also increased. Ruby, an early variety from Canada, occupied 330,000 acres here in 1924, but has decreased since as it did not escape rust. Kota, a resis-

[15] Mark Alfred Carleton, Hard Wheats Winning Their Way, in U. S. Dept. Agr., *Yearbook* 1914: 391–420. 1915.

tant selection from a Russian introduction occupied nearly 500,000 in 1924, but in turn has been replaced by Ceres. The latter, a high-quality selection from a Marquis-Kota cross developed by Waldron of the North Dakota station, is resistant to both rust and drought. First distributed in 1925, it occupied some 500,000 acres in 1929. Still newer varieties, now becoming commercially important, are Marquillo in Minnesota, Hope in South Dakota, Supreme in Montana, and Reward in Canada.

Durum wheats. The durum industry in this country is largely the result of the vision and persistence of Carleton. He obtained large quantities in Russia and North Dakota in 1900 and distributed them widely in the Great Plains area. This was followed by coöperative chemical and milling and baking tests. While he recognized early that they were not necessarily rust resistant,[16] it was their relative resistance to rust and drought that increased the acreage so rapidly in the first decade of their progress. Improved varieties such as Acme and Nodak, produced coöperatively in the Dakotas, and Mindum of the Minnesota station, are becoming grown but the greater part of the 4 to 5 millions of acres are sown still with the original introductions.

Improvement of wheat by genetic methods

Many of our most widely grown wheats have been the result of natural or controlled hybridization. While superior in some one or more characters they are unsatisfactory in others, and further improvement is required.

Breeding new wheats having all the characters and qualities desired, however, has not proved to be an easy task. Multiple factors, and the usual absence of transgressive segregation, make the problem complex and the progress correspondingly slow. Cold injury to wheat may be due to one or more of many different factors in the environment, and damage from stem rust may be caused by any one or more of more than 60 physiologic forms already known.

[16] *Ibid.*, Improvements in Wheat Culture, in U. S. Dept. Agr., *Yearbook* 1896: 489–498. 1897.

Resistance to or escapement from attack may lie in morphological, physiological, or chemical characters, or in a combination of these. Resistance to any two or more conditions in the environment, or physiological forms of stem rust, may be inherited separately or together. Kanred wheat, for instance, is highly resistant in the seedling stage to attack by at least 11 forms of stem rust, while Hope, a new spring wheat, is resistant in the adult stage to all forms so far tested on it.

Great progress has been made in laying foundations, in spite of the many handicaps. Leighty and Sando, and Love and his associates, have made progress with inter-specific hybrids and have shed much light on the possible origin of the species and subspecies of wheat. Aamodt, Clark, Gaines, Hays, Love, McFadden, Parker, and Waldron, and their associates, have made important contributions to the theoretical genetics of wheat by determining the mode of inheritance of various characters and qualities. These and other workers are using this knowledge in practical breeding of improved varieties.

Progress in wheat protection

The insects, fungi, and other parasites of wheat, now including bacteria and viruses, have increased in kinds, geographic distribution, and total destructiveness. This has stimulated increased efforts at control. Notable progress has been made, as for instance, in destroying grasshoppers by poison baits, eradicating grain moths and weevils in mills and elevators by fumigation, controlling many fungi by new compounds of copper and mercury, especially in dust form, and greatly reducing the losses from such terrifically destructive diseases as stem rust through eradicating the alternate host, the European barberry, of which some 18,000,000 bushes have been destroyed in 13 States in the last 13 years. Not least in importance has been the coöperative isolation and breeding of strains resistant to many of these diseases, discussed above.

On the other hand, pathologists have discovered that the causal organism, in most cases, is not a single entity but a complex of physiological forms having different infection capabilities and

geographic distribution. More than 60 are known for the stem-rust organism alone. Finally, Canadian rust specialists have discovered the processes by which such forms probably are created through hybridization in the pycnial stage on the barberry.

Space limitations permit no discussion of the noreworthy advances made in studies of soils, methods of tillage and seeding, the morphology and cytology of the wheat plant, its biochemical and physiological development and the various means of influencing these, and, finally, the development of harvesting, cleaning, and milling machinery and technique. Individually and collectively, these have had an important part in the recent improvement of the quantity and quality of American wheat.

NEWS NOTES AND COMMENTS

THIRTEENTH ANNUAL MEETING OF THE AGRICULTURAL HISTORY SOCIETY

Thirty-eight were present at the dinner and forty-five at the thirteenth annual business meeting and program of the Agricultural History Society held in Washington, D. C., on April 22, 1930. The society's president, E. Merton Coulter, presided.

The nominating committee, consisting of Nils A. Olsen (chairman), Rodney H. True, and Herbert A. Kellar, having mailed ballots to members of the society, reported the following elected for the year 1930–31: for president, Avery O. Craven, University of Chicago; for vice-president, W. Freeman Galpin, Syracuse University; for secretary-treasurer, O. C. Stine, U. S. Department of Agriculture; elected members of the executive committee, L. C. Corbett, U. S. Department of Agriculture, and B. T. Galloway, U. S. Department of Agriculture.

The literary program consisted of two very interesting and valuable papers. Dr. Carleton R. Ball, formerly principal agronomist in charge, Office of Cereal Crops and Diseases, Bureau of Plant Industry U. S. Department of Agriculture, spoke extemporaneously on the History of American Wheat Improvement. Professor E. Merton Coulter read his presidential address, his subject being Southern Agriculture and Southern Nationalism Before the Civil War. The questions and discussions following the addresses may well be taken as a tribute to their value. The paper which Dr. Ball has prepared on his subject appears elsewhere in this issue of *Agricultural History*. Professor Coulter's paper will appear in the July number.

The society's secretary-treasurer, O. C. Stine, reported sixty-one new members since the last annual meeting, stressing particularly the interest of Europeans largely as a result of the article in the society's journal for October, 1929, entitled "The Size of

English Cattle in the Eighteenth Century," and the activities of its author, G. E. Fussell of the British Ministry of Agriculture and Fisheries.

The auditing committee, consisting of F. L. Lewton (chairman), Mary G. Lacy, and Margaret Warner, reported that it had audited and approved the report of the secretary-treasurer covering the period from April 15, 1929, to March 31, 1930.

SECRETARY-TREASURER'S STATEMENT OF RECEIPTS AND EXPENDITURES

April 15, 1929, to April 1, 1930

RECEIPTS

Balance in checking account on April 15, 1929	$136.88
Interest on 1st Trust Note held by McLachlen Banking Corporation to August 30, 1929	6.00
Note sold and money deposited to Agricultural History account	201.66
Dues for 1929 and earlier paid since April 15, 1929	217.50
Dues for 1930 and $20 on a life membership	384.00
Back numbers of Journal and Papers sold since April 15, 1929	75.00
Check from C. R. Woodward for additional reprints	9.47
Check from St. G. L. Sioussat of Philadelphia for additional reprints	2.80
Check for $30 advanced to the Society by O. C. Stine Oct. 17, 1929 to pay printing bill	30.00
	$1063.31

EXPENDITURES

Printing and other expenses incidental to publishing the four issues of the journal for 1929	$968.80
Mimeograph work	3.65
Check for $30 returned to O. C. Stine for loan made Oct. 17, 1929	30.00
Miscellaneous expenses, mailing of proof, telegrams, express charges	5.73
Stamps for mailing circular letters to libraries and teachers of rural sociology (about 1200 on list), mailing of programs, notice of dues, and issues of journal mailed out upon request	53.55
	$1061.73

Total Receipts	$1063.31
Total Expenditures	1061.73
In checking account on March 29, 1930	$1.58
Outstanding bills: Printing bill for the issue of the journal for January, 1930, probable cost	$150.00

THE DANIEL PARRISH WITTER AGRICULTURAL MUSEUM

The Daniel Parrish Witter Agricultural Museum, erected on the State Fair grounds at Syracuse by the State of New York as a result of the efforts of the New York State Agricultural Society, was formally dedicated on August 30, 1928. Governor Alfred E. Smith presented the building to agriculture, and it was accepted by Commissioner Berne A. Pyrke of the Department of Agriculture and Markets, E. R. Eastman, president of the New York State Agricultural Society, and other agricultural leaders. The building is named in honor of Assemblyman Daniel P. Witter of Tioga, chairman of the assembly committee on agriculture, and a well known leader in agriculture.

One wing of the building is set aside as a memorial room. On its walls are photographs of the persons who have served as president of the New York State Agricultural Society, now in its ninety-ninth year. This room is used for lectures, old-time singing contests and similar events. The other wing is filled with agricultural implements and early household utensils. In the main part of the building demonstrations, showing the early handicrafts, have been held, and it is proposed to continue these as long as possible. Last year there were demonstrations of spinning of wool and flax, weaving, cobbling with wooden pegs, pottering, shingle shaving and coopering. The fireplace and Dutch oven were used to demonstrate the cooking of old-time dishes by old-time methods. For the coming fall it is proposed to enlarge the cooking demonstrations and vary those of other handicrafts as much as possible. The demonstrations form one of the most interesting exhibits on the fairground, if the number of persons attracted is any indication.

The New York State Agricultural Society has also selected with great care a typical log house from the many log cabins which still exist in the State. It has been moved to the museum building and erected exactly as it stood on its original site. It has been furnished with articles commonly used in the log cabins of early New York. During the days of the State fair an elderly couple sit in the cabin doing knitting, shoemaking, and other kinds of work.

It is planned to plant the grounds of the Museum with old fashioned perennials, annuals, and shrubs. A white picket fence is to be built, and also walks of gravel and stepping stones taken from prominent homes. The information contained in this statement regarding the Daniel Parrish Witter Agricultural Museum has been supplied to the assistant editor by Charles H. Baldwin, president of the New York State Agricultural Society.

THE VIRGINIA COLLECTION AT THE UNIVERSITY OF VIRGINIA

During the past two or three years the University of Virginia has given special attention to gathering historical material on Virginia to form a collection in its library. The recent efforts are the result of the interest and concern of President Edwin Anderson Alderson, the growth of the Department of Graduate Studies, and the investigations made possible by the establishment of the Institute for Research in the Social Sciences at the University. Such projects of the Institute as the forthcoming Bibliography of Southern History Since 1865 by Doctors Dumas Malone and Lester J. Cappon did much to reveal the extent of Virginia material for research.

Since 1899 the income from a bequest of $10,000 from the estate of the late Alfred Henry Byrd has been avilable for the purchase of Virginiana. The collection now consists of over 3,000 books and pamphlets and about 2,500 manuscripts and photostat copies. The manuscripts include letters and documents by Jefferson, Madison, Monroe, Richard Henry Lee, Francis Walker Gilmer, Joseph Carrington Cabell, Edgar Allan Poe, and John R. Thompson, and material relating to the history of the University of Virginia.

During the next year Professor Cappon will devote his time to conducting for the Library a survey of the book and manuscript material in Virginia and will also act as collector. Efforts are being made to increase substantially the funds available for the purchase of books, pamphlets, and manuscripts. A suite of four rooms in a separate one-story terrace building adjoining the University Library at the Rotunda has been set aside for the housing of the collection.

The University authorities are now making a special appeal to those who possess records of Vigingia's past to make them available for this Collection. The types of material especially desired include old letters, diaries, records, and manuscripts of original composition; old documents, such as wills and deeds; old Virginia newspapers; and old books and magazines about Virginia, by Virginians, or published in Virginia. Material intended for the Virginia Collection and correspondence concerning it may be addressed to the University Librarian, University of Virginia, University, Virginia.

THE TEN MASTER MINDS OF DAIRYING

The Ten Master Minds of Dairying is the title of a valuable 78–page booklet recently issued by the Meredith Publishing Company, of Des Moines, Iowa. It contains biographical sketches of the ten men regarded by 56 present-day leaders of dairying as the most responsible for improvements in dairying since the days of hand skimming of milk and farm-made butter. A chapter is devoted to each of the following: Stephen Moulton Babcock; William Dempster Hoard; Clarence Henry Eckles; Carl Gustaf Patrik De Laval; Elmer Verner McCollum; Louis Pasteur; Theophilus Levi Haecker; Gail Borden; William Arnon Henry; and Otto Frederick Hunziker. These sketches originally appeared in the *Dairy Farmer* and *Successful Farming*.